

YOUNG ASTRONOMERS NEWSLETTER

NEW STANDARD TO BE SET FOR THE KILOGRAM

Going back to 1889, the international community of metrologists set certain standards of measurement that allowed all cooperating countries to compare and relate certain measured quantities. This made it easier to compare items of commerce and to communicate scientific measurements. In 1960, the metrologists established seven base units that form the foundation of all other measurements. We call this the Meter-Kilogram-Second (MKS) system, also known as the “metric system”. The seven base units are: the meter, for length, the second, for time, the mole, for quantity of matter, Kelvin, for temperature, candela for luminosity intensity, ampere for electric current, and the kilogram, for mass.

The ideal construction of these base units is to relate them to certain invariant quantities of nature, such as the speed of light in a vacuum or the triple point of water. This has been successfully done, except in the case of the kilogram. This quantity of mass is based on the mass of a cylinder of a platinum-iridium alloy (37.17 mm diam. by 37.17mm height). Unfortunately, careful monitoring of this prototype kilogram (stored at the International Bureau of Weights and Measures, near Paris, France) has shown minute changes in its mass. There seems to be a tiny decrease in mass, on the order of 50 micrograms (10^{-6} g).

This makes the metrologists uneasy and they searched for an invariant quantity of nature to serve as the basis for the kilogram. They have settled on the Planck constant (h), which is related to light energy: $E = hf$ (f is the

frequency of the light). Planck constant is equal to exactly: $6.62607015 \times 10^{-34}$ Joule-seconds.

The energy unit Joule is equal to $\text{kg}\cdot\text{m}^2/\text{s}^2$, so, you see where the kilogram fits in.

The new definition of the kilogram will be adopted on Metrology Day: May 20, 2019. In addition, there will be redefining of the bases for the ampere, the kelvin (temperature) and the mole (quantity of matter). [C&E News, Nov. 26, 2018; <https://www.nist.gov/si-redefined>].

VOYAGER 2 HAS NOW PUSHED INTO INTERSTELLAR SPACE

Voyager 2, and its partner, Voyager 1 are both said to be out beyond the influence of the Sun. After more than 41 years of record-breaking travel, the two spacecrafts have escaped the boundary that we call the heliosphere. Voyager 1 did it in 2012 and NASA announced on December 10 that Voyager 2 has now also followed into the enormity of space between the stars.

The heliosphere is likened to a bubble that represents the limit of charged particles flowing out from the Sun. Voyager 2 carries an instrument that can measure the intensity of radiation in its surroundings. There will be a change in energy intensity that’s measured as Voyager 2 passes from inside the heliosphere (low energy) into interstellar space loaded with high energy cosmic ray particles. Unfortunately, Voyager 1’s instrument failed at the crucial time of its escape from the heliosphere, so we don’t have a record of that event for the earlier spacecraft.

Voyager 2 is way out there, at a distance of about 10 billion miles and is travelling at about 44,000 mi/hr. Transmission of signals to and

from the spacecraft takes about 16 hours (one way, at the speed of light).

Both spacecrafts were launched in 1977. They both skirted the outer gas giants and discovered

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several moons around them. They also made historic scientific measurements and photographs of planet rings and atmospheric dynamics. Their nuclear-thermal- electric power sources are expected to last until about 2025. [Space.com; Dec. 19, 2018].

TIME FOR CREATION OF ARIZONA'S METEOR CRATER IS MODIFIED.

The Barringer meteor crater was created when a large asteroid hit the Earth many thousands of years ago. An article in January's "Astronomy" describes some of the geological types of materials that were ejected from the impact site. Re- examination of the condition of ejected rocks and measuring the radioactivity of certain constituent elements has moved the impact date back from about 50,000 years ago to about 60,000 years, or older.

The crater diameter is about $\frac{3}{4}$ of a mile and its current depth is 570 feet, although its original depth could have been 100 feet lower, as inflow of water-carried debris gradually added height over the centuries. The asteroid has been estimated to have been about 160 feet in diameter and had a weight of about half million metric tons. At impact, it released energy equivalent to about 700 times that of the atom bomb that exploded over Hiroshima. It consisted mostly of iron, with about 7 percent nickel.

The crater is located about 185 miles north of Phoenix. It has been owned by the Barringer family since 1903.

EUROPEAN SPACE AGENCY'S MARS EXPRESS ORBITER DISCOVERS A PERMANENT DEPOSIT OF SURFACE ICE

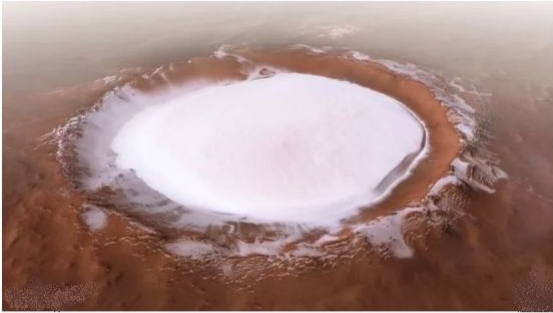
The European Space Agency's Mars Express Orbiter has taken stunning photos of the interior of the Korolev Crater which has a deposit of ice that is about 6,000 feet thick.

Continued observation has led investigators to conclude that the huge block of water ice does not melt or sublime because of the unique behavior of air (Mars "air" is about 1 percent the density of Earth's atmosphere, and consists of 98% carbon dioxide.) over the crater. The Martian atmospheric gases settle into the depths of the crater and create an insulating protective blanket which allows the ice block to remain intact. Korolev Crater is located in the cold northern highlands that encircle the northern polar cap, which also favors the preservation of the ice.

The crater is about 51 miles wide and 1.2 miles deep. The ice depth and width dimensions give us a volume of over 500 cubic miles of ice. This is about equal to the volume of The Great Slave Lake in Canada. It has been known for many years that there is a permafrost layer of ice under the Martian surface, but this is the first time that water ice has been found visible on the surface.

There are also strong indications that there may be ice hidden deep in craters on the Moon. This amazing discovery comes at the 15th anniversary of the Mars Express Orbiter which was launched in 2003 and reached the red planet on December 25, 2003.

[Space.com; www.esa.int].



VIEW OF KOROLEV CRATER SHOWING THE THICK DEPOSIT OF ICE (Photo by ESA Mars Express orbiter)
Credit: ESA/DLR/FU Berlin cc BY-SA 3.0 IGO

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BIRTHDAYS IN JANUARY: Stephen Hawking (Brit.) b. Jan. 8, 1942; d. Mar. 14, 2018. Cosmologist. Beginning of time and space, Big Bang Theory.

Robert Woodrow Wilson (Amer.) b. Jan. 10, 1936, radioastronomer. Co-discoverer of the cosmic microwave background. Nobel Prize 1978 (with Allen Penzias).

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MOON PHASES IN JANUARY: New: Sun. the 6th; First Qtr.: Mon. the 14th; Full: Mon. the 21st; Last Qtr.: Sun. the 27th. There will be a total lunar eclipse on the night of Sunday - Monday, Jan. 20 - 21. (See below) (see January issue of Sky & Telescope for more details)

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THE PLANETS IN JANUARY: **Mars** is still pretty bright (mag. 0.5 to 0.9) It is about half way up to the zenith and then sets around 11 p.m. **Venus** (mag. -4.5) glows brightly in the mornings and reaches its highest altitude during the first week of the month. It gradually drops while **Jupiter** comes up to meet it and we have a stunning conjunction on the 22nd. **Saturn** hides on the other side of the Sun until it appears low in the southeast during the last week of the month. **Mercury** is difficult to see during the month as it heads for the far side of the Sun.

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THE QUADRANTID METEOR SHOWER: This meteor shower is predicted to be very good this year, especially since we will be having a new moon. The meteor production begins in the last week of December and peaks around the third of January and comes to an end around the 12th.

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THE JANUARY FULL LUNAR ECLIPSE is quite special this year. It occurs when the Moon is at perigee, a close point in its orbit around the Earth. So, it will appear a teenie bit larger to us as it passes directly through the shadow of the Earth. The eclipsing process will last almost three and a half hours, with total eclipsing lasting 63 minutes. For North Carolinians, total eclipsing will take place from 11:41 p.m. on Sunday the 20th to 12:44 a.m. on Monday the 21st. In addition, the earth-shadowed Moon will take on a ruddy (brown-red) color and it will be quite high and prominent in the sky. The January full moon has the folklore name The Wolf Moon. Another bonus to this eclipse is that most people will be on a three-day weekend holiday (Martin Luther King, Jr. day on Monday). The total eclipse will be visible over all of north and south America. Let's cross our fingers for a cloud-free night.

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FORSYTH ASTRONOMICAL SOCIETY: Meetings at Kaleideum North (formerly SciWorks) are held the second Wednesday of the month at 7:30 p.m. Visitors are welcome. For club activities and special events, see the FAS web site at www.fas37.org You can also get information about FAS at the Kaleideum North front desk: 336-767-6730, ext. 1000.

The club will hold a public viewing of the lunar eclipse that takes place over late evening of Sunday, January 20 to the early morning of Monday the 21st. The viewing will take place at the Kaleideum

